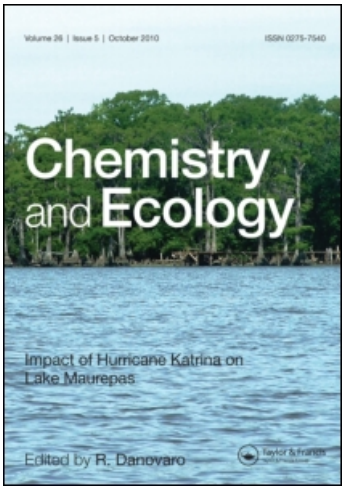

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FORWARD

The PRISMA II Programme in the Adriatic Sea: Background and General Introduction

Coastal marine environments are fragile ecosystems increasingly affected by anthropogenic inputs. Through river run-off, coastal areas receive pollutants, both dissolved and associated to suspended particles. Coastal areas generally display a relatively narrow and steep continental shelf extending up to 150–200 m depth, that combined with highly dynamic hydrological conditions allow a relatively rapid dilution of the effluents and/or contaminants, thus reducing the potential impact of these inputs.

This is not the case of the Adriatic Sea, which is a large continental shelf separated from the Mediterranean Sea by the Otranto Strait. The Northern Adriatic basin is characterised by: (i) shallow depths (less than 50 m); (ii) a relatively high light penetration (generally $>0.1\%$ of incident Photosynthetic Available Radiation reach surface sediments); (iii) high river input and freshwater runoff. Therefore, this basin exhibits both eutrophic and oligotrophic conditions within a smaller temporal and spatial scale.

Despite the Adriatic Sea accounts only for $1/250$ of the overall Mediterranean Sea volume, the freshwater input from the Po River in its northern part accounts, alone, for about 30% of the river inputs of the entire Mediterranean basin. All these factors make the semi-enclosed Adriatic Sea basin a peculiar system where its pattern of cyclonic circulation can, in particular conditions strongly limit the dilution of allochthonous loads, especially in its northern part.

The Northern Adriatic, an economically crucial Mediterranean area characterised by important fisheries and a relevant tourist industry, displayed important ecological changes in the last decades. One of the most evident changes regard the decrease of the dissolved nutrient concentrations, particularly reactive phosphates (as a consequence of the act of Italian Government on phosphorus reduction in the detergents). There are also evidences of major changes at the level of primary producers as indicated by the progressive decrease of dinoflagellate blooms along the north-western Adriatic coasts.

In the last 20 years, the Adriatic has been characterised by an increasing number of "ecological crises" linked to its malfunctioning, which frequently resulted in the production of huge amounts of gelatinous aggregates (also described as "dirty sea"). Mucilage appearance interested primarily the northern and central basins and damaged considerably fishery and tourist activities. The decay of large amounts of organic matter after their settlement on the sea floor might cause a progressive oxygen depletion, leading to hypoxia and sometimes to anoxia, particularly evident during prolonged periods of vertical stratification and/or in reduced hydrodynamic conditions.

This phenomenon stimulated a number of environmental studies devoted to identify the causes and to the development of models for predicting future episodic events. Although the knowledge of causes of the Adriatic eutrophication are now well understood, we are still far from being able to predict the appearance of the so called "dirty sea" phenomena.

With regard to this last process, several hypotheses have been proposed as possible explanations (climatological changes, specific meteorological and oceanographic conditions, reduction of the Po river discharge, increased N:P ratios, accumulation of low-degradable organic matter and others), but none of them appears to be exhaustive.

Natural events of "dirty sea" have been recorded since 1729, and, in the following two centuries from 11 to 16 further events have been recorded. The same uncertainty about the number of events suggests how far we are from an universally shared definition of this phenomenon, and which procedures, critical parameters and protocols are needed for its analysis and quantification. In the following sixty years (from 1930 till 1990), another 7 events has been recorded, and in the last decade (1990 till 2000), 4 events have been described and investigated. We are still not in the condition to clarify whether such increased frequency is due to the increased monitoring of the Adriatic coasts, but certainly these events provoked strong reactions in the public opinion.

The Adriatic Sea and its trophic features have been investigated in several national and international programmes, including bilateral projects between Italy and former Yugoslavia. The Programme PRISMA II was born with the aim of coping with the unanswered scientific questions still open after previous programmes on the Adriatic. This 3-year programme (carried out from 1996 to 1998) represents the second phase of the Research and Experimentation for the Safeguard of the Adriatic Sea, following the first preliminary phase (PRISMA I).

This monograph includes the results presented at the last Workshop of the Programme PRISMA II, workpackage: "Biogeochemical Cycles", which involved 20 research groups from National Research Council and several Universities. This interdisciplinary work package was designed to investigate biogeochemical cycles of carbon, nitrogen and phosphorus in order to quantify their fluxes through different compartments of the food web and to assess the balance between production and degradation processes, including both particulate and dissolved fractions.

The rational behind this is that the comprehension of the eutrophication process and the causes of the formation of mucilage aggregated is not possible without a deep understanding of the "intimate" factors controlling biogeochemical cycles in this area.

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